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ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/410,800	Applicant(s) ACHARYA ET AL.
	Examiner Nhan T. Tran	Art Unit 2615

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 3.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 1/6/2004 have been fully considered but they are not persuasive.

a). On page 8, the Applicant argues that Maenaka fails to teach or suggest comparing "relative changes" in a particular color pixel signal level for two mutually orthogonal directions and there is nowhere in Maenaka teaching comparing "relative changes" in a particular color pixel signal level.

In response, the Examiner respectfully disagrees with the Applicant and submits further explanations:

As disclosed in col. 9, lines 1-31, the horizontal correlation and the vertical correlation values of the specific pixel (the particular color pixel) with respect to pixels around the specific pixel are taken into consideration in the weighted addition circuit 72. Please refer to Fig. 8(B) and equations (15) & (16) in col. 8 for calculations of the horizontal and vertical correlation values Sh and Sv of the center pixel B22. According to Maenaka, the horizontal weighing coefficient Kh becomes large in a case where the correlation in the horizontal direction is stronger than the correlation in the vertical direction, that is, in case where the correlation value Sh is smaller than the correlation value Sv, and vice versa in view of equations (17) and (18) and the relationship of Kh + Kv = 1. Although Maenaka does not explicitly disclose "comparing" in context, the vertical and horizontal correlation values Sv and Sh are inherently involved in the comparison for relative changes in the specific pixel as a nature of calculation expressed in the

equations (17) and (18) to maintain the relationship of the coefficients Kh and Kv within a constant range as provided above. It is also illustrated in Fig. 9 that the color signal value of the specific pixel is determined as Ro, Bo, Go being equal to 0.2 which are calculated in the weighted addition circuit 72 in correspondence to the vertical correlation value detected as a stronger correlation. Therefore, the limitation of comparing relative changes in a particular color pixel signal level for two mutually orthogonal directions is inherent in Maenaka.

b). In the last paragraph of page 8 to page 9, the Applicant asserts that Hamilton fails to teach or suggest comparing "relative changes" in a particular color pixel signal level for two mutually orthogonal directions.

In response, the Examiner respectfully disagrees with the Applicant. As clearly disclosed by Hamilton in Fig. 3 and col. 4, lines 47-58, the two pixel classifier values are compared at block 52 and tested for equality. In the likely event that one value is smaller than the other, the interpolation method corresponding to the smaller value is selected at block 54. If the values are equal, then the default interpolation method is selected at block 56. The pixel classifiers are not only composed of Laplacian second order terms for chroma data (red or blue) but also composed of gradients for green data as clearly shown in detail in col. 5, lines 25-50, wherein the pixel classifier DH in horizontal direction comprises |G4-G6| while the pixel classifier DV in vertical direction comprises |G2-G8|. Therefore, Hamilton does teach comparing relative changes in a particular color pixel signal level for two mutually orthogonal directions as required in claims 1, 13, 16 and 19.

In view of the above, the Examiner believes that the interpretation of the present claimed invention does read on the cited references at least for the reasons discussed above and as stated in the following Office Action.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1 – 6, 11, 12 & 16 – 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Maenaka et al (US 5,552,827).

Regarding claim 1, Maenaka discloses a method of interpolating color pixel from a subsampled color image comprising:

for a particular pixel location (i.e., center pixel) in the subsampled image, comparing relative changes (using the relationship Kh + Kv = 1 and vertical and horizontal correlation values Sv and Sh; col. 9, lines 1-31) in particular color pixel signal level for two mutually orthogonal directions (vertical and horizontal directions) across the particular pixel location using pixel signal values immediately adjacent to the particular pixel location (Fig. 8(B); equations (15) and (16) in col. 8);

computing a color signal value (Ro, Go, Bo; for example, missing green at B22 in Fig. 8(B)) for that particular pixel location for a color plane other than the color plane of the pixel signal value in the subsampled color image at that location by relatively weighing the pixel signal values, the relative weights, at least in part, on the relative change of pixel signal level in a particular direction. See Figs. 2, 8, 15; col. 2, lines 37-43; equations (15) & (16) in col. 8; col. 9, lines 1-54 and it should be noted that R color presents a color plane of Red, G color presents color plane of Green.

Regarding claim 2, computing signal a color signal includes relatively weighing the pixel signal values by relatively weighing more heavily the pixel signal values associated with the direction increasing less relatively in pixel signal value level for the particular pixel location (see col. 9, lines 1-19).

Regarding claim 3, the subsampled image comprises an image in RGB space format (see Figs. 8 & 13).

Regarding claim 4, the subsampled color image comprises a Bayer pattern (see Figs. 8 & 13).

Regarding claim 5, the color plane of the pixel signal value at the particular pixel location comprises R color plane (see equations (3), (9) & (12) in col. 6 & 7 or equations (36) & (39) in

col. 15 wherein missing Red color is computed based on color values of Green and Red in the Green and Red color planes, respectively);

the two mutually orthogonal directions comprising the horizontal and vertical directions; the particular color plane for the color signal value being computed comprises the G plane (i.e., plane of G22 in Fig. 8(A) or G23 in Fig. 13(A)); and the particular color for the pixel signal value levels being compared comprises G (see equations (3), (9) & (12) or equations (36) & (39) & col. 13, line 60-65 wherein all color planes are utilized for detecting correlation).

Regarding claim 6, the color plane of the pixel signal value at the particular pixel location comprises B color plane (see equation 6 in col. 7 or equations (44), (45) & (47) wherein missing Blue color is computed based on color values of Green color plane and Blue color plane);

the two mutually orthogonal directions comprising the horizontal and vertical directions (for computing horizontal and vertical values, i.e., Bh & Bv);

the particular color plane for the color signal value being computed comprises the G plane (i.e., plane of G22); and the particular color for the pixel signal value levels being compared comprises G (see equation 6 or equations (44)-(47); col. 13, lines 60-65 wherein all color planes are utilized for detecting correlation).

Regarding claim 11, the color plane of the pixel signal value at the particular pixel location comprises the G color plane; the two mutually orthogonal directions comprising the horizontal and the vertical directions; the particular color plane for the color signal value being

computed comprises the B plane; and the particular color for the pixel signal value level being compared comprises B hue (G-B) as shown in col. 14, lines 14-18 & line 54 – col. 15, line 58.

Regarding claim 12, see claim 11 for similar analysis in which R color is involved to calculate green color in equation (43) in col. 15.

Regarding claim 16, the claimed limitations are analyzed in claim 1.

Regarding claim 17, the claimed limitations are analyzed in claim 3.

Regarding claim 18, the claimed limitations are analyzed in claim 4.

Regarding claim 19, the claimed limitations are analyzed in claim 1, wherein a computing platform is presented by the hardware circuitry shown in Figs. 2, 10 & 14.

Regarding claim 20, the claimed limitations are analyzed with respect to claim 3.

3. Claims 1, 13, 16 & 19 are rejected under 35 U.S.C. 102(b) as being anticipated by Hamilton, Jr. et al (US 5,629,734).

Regarding claim 1, Hamilton discloses a method of interpolating color pixel signals from a subsampled color image comprising:

for a particular pixel location (A5) in the subsampled image, comparing relative changes in a particular color pixel signal level for two mutually orthogonal directions (horizontal and vertical directions) across the particular pixel location using pixel signals values (G2, G4, G6 and G8) immediately adjacent to the particular pixel location (see Fig. 3; col. 4, lines 34-53 and col. 5, lines 25-50);

computing a color signal value (missing green) for that particular pixel location for a color plane (color plane containing A5 which is either blue or red color plane) other than the color plane of the pixel signal value in the subsampled color image at that location by relatively weighing the pixel signal values (multiplying the pixel values by ½ = 0.5, or ¼ = 0.25), the relative weights depending, at least in part, on the relative change of pixel signal value in a particular direction (see col. 5, line 50 – col. 6, line 29, wherein missing green pixel (G5) at A5 is computed as G5H = 0.5(G4+G6) + …; G5V = 0.5(G2+G8) + …; G5A = 0.25(G2+G4+G6+G8) based on the comparison results).

Regarding claim 13, the claimed limitations are analyzed in claim 1. Additionally, a storage medium, having stored thereon instructions to be executed by a system for interpolation of color pixel values from a subsampled image is inherent in Hamilton in order for the system to function as demonstrated by Figs. 3 & 5 using software instructions).

Regarding claim 16, the claimed limitations are analyzed in claim 1.

Regarding claim 19, the claimed limitations are analyzed in claim 1, wherein a computing platform is presented by the circuitry shown in Fig. 1.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 7 – 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maenaka et al (US 5,552,827) in view of Hamilton, Jr. et al (US 5,629,734).

Regarding claim 7, Maenaka discloses the color plane of the pixel signal value at the particular location comprises the R color plane (see Figs. 8 & 13 wherein the particular, i.e., center pixel, must comprise three primary colors R, G and B which belong to Red, Green and Blue color planes, respectively);

the particular color plane for the color signal value being computed comprises the B plane (presented by B color) and the particular color for the pixel signal value level being compared comprises B hue (G-B) as shown in col. 14, lines 14-18.

Maenaka does not teach that the two mutually orthogonal directions comprising the main diagonal and the secondary diagonal directions. However, as taught by Hamilton, two diagonal

directions with respect to a target color pixel are used in computations of pixel classifiers and a chroma (red/blue) interpolation process so that artifacts in output image are substantially reduced as shown in Fig. 5; col. 4, line 63 – col. 5, line 20.

Therefore, it would have been obvious to one of ordinary skill in the art to modify Maenaka with to include the teaching of Hamilton by implementing main diagonal and secondary diagonal directions for the chroma (red/blue) interpolation process for reducing artifacts at image output.

Regarding claim 8, Maenaka discloses that the interpolation of a blue pixel signal value at a green pixel location is based at least in part on computed B pixel value levels for red pixel locations adjacent the green pixel location and also on existing blue pixel locations adjacent the green pixel location in a mutually orthogonal direction (horizontal or vertical) to the adjacent red pixel locations in the subsampled color image (see col. 14, line 54 – col. 15, line 58 wherein a missing color component is calculated based on the other two adjacent color components and its existing adjacent color component).

Regarding claim 9, the claimed limitations are analyzed with respect to claim 7 wherein R hue is presented by G-R (Maenaka, col. 14, lines 14 – 18), and equations (2), (6) & (41) present color values of Blue plane (Maenaka, col. 14, line 54 – col. 15, line 58).

Regarding claim 10, the claimed limitations are analyzed with respect to claim 8 wherein red pixel signal value is calculated instead of blue pixel signal value.

5. Claims 13 – 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maenaka et al (US 5,552,827) in view of Yamashita (US 5,513,281).

Regarding claim 13, Maenaka discloses the limitations of claim 13 as analyzed in claim 1 by means of hardware system. Maenaka does not expressly teach software instructions which are stored in a memory to be executed for interpolating color pixel values from a subsampled image. However, as taught by Yamashita, it is obvious that interpolation process is either realized by means of hardware system or equivalent software procedures as suggested in col. 11, lines 31-34.

Therefore, it would have been obvious to one of ordinary skill in the art to implement the interpolation process by using either hardware system or equivalent software procedures stored in a memory such as ROM or removable memory as obvious variations.

Regarding claim 14, the claimed limitations are analyzed with respect to claim 3.

Regarding claim 15, the claimed limitations are analyzed with respect to claim 4.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nhan T. Tran whose telephone number is (703) 605-4246. The examiner can normally be reached on Monday - Thursday, 8:00am - 6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Andrew B Christensen can be reached on (703) 308-9644. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

NT.

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